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# Galileo Doppler Wind Experiment

for the period

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# Summary

The primary goal of this research deals with Doppler wind retrieval preparations for the upcoming Galileo Jupiter probe mission in December, 1995. In anticipation of the arrival of Galileo at Jupiter, software development to read the radioscience and probe/orbiter trajectory data provided by the Galileo project and required for Jupiter zonal wind measurements is continuing. Sample experiment radioscience data records and probe/orbiter trajectory data files have been provided by the Galileo Radioscience and Navigation teams at the Jet Propulsion Laboratory, respectively, and have been used for the first phase of the software development. The software to read the necessary data records has been completed. The procedure by which the wind retrieval will take place will begin with initial consistency checks of the raw data, preliminary data reductions, wind recoveries, iterative reconstruction of the probe descent profile, refined wind recoveries, and subsequent anomalous wind retrievals. At each stage of wind recovery consistency will be checked an maintained between the orbiter navigational data, the radioscience data, and the probe descent profile derived by the Atmospheric Instrument Team.

# Recent Progress

During the past ten months the software for reading the Galileo experiment data records has been developed and initial tests have been performed. The data files of primary importance are the Probe System/RRH Radioscience Experiment Data Record described in the JPL Software Interface Specification (SIS) 213-01, the Probe System Trajectory File described in SIS 230-09, and the Probe/Orbiter Trajectory Predicts described in SIS 210-12. Currently the development of the data analysis and wind retrieval software is underway. The key accomplishments have been:

1. development of software to read radioscience data from tape, probe and orbiter trajectory data from disk,
2. conversion of radioscience binary data to hexadecimal to ascii,
3. conversion of probe/orbiter trajectory data in inertial (x,y,z) coordinates to Jupiter-centered rotating coordinates,
4. check probe and orbiter latitudes/longitudes for consistency.
5. calculation of nominal probe/orbiter range rate as function of time.
6. calculation of basic geometry (probe-orbiter planet-centered angle $\gamma$, the line-of-sight azimuth, probe aspect angle, and the time rate of change of each angle).

We have also completed the development of software to read the "Quick Look" (1/2 resolution) data that will be received several days following the probe mission. The quick look data, provided in unformatted ascii, will contain the probe radioscience (frequency) data vs. time. This data set will provide us with an opportunity to conduct a preliminary check of the radioscience data, and determine telemetry frequency statistics. We will not, however, have the opportunity to conduct a preliminary wind retrieval until the probe and orbiter reconstructed trajectories are available from the Navigation and the Atmospheric Structure Instrument teams.

A final major accomplishment in 1994 has been the completion of the Galileo Probe USO trend analysis. Since launch in 1989 three in-flight tests have been conducted - System Functional Tests (SFT) in 1989 and 1990, and a Mission Sequence Test (MST) in 1992. The data from these tests has been collected and analyzed using the probe radioscience data analysis software also completed in 1994. Modeling of the data is now complete. The drift rate of the probe USO has been characterized based on the consistency of the three flight tests. Variations in the long-term drift rate allows an estimate of the variance in the probe USO frequency time profile. The estimated variance will be used to establish limits (error bars) on the Jupiter wind retrieval accuracy.

The modeling scheme used is a rational fraction algorithm called Thiele's continued fraction. The predicted December 1995 fractional drift rate was estimated to be $1.73 \times 10^{-9} \pm 0.93 \times 10^{-10}$. This uncertainty is within $7 \times 10^{-12}$ of NASA's specification. Note that the predicted fractional drift rate for December of 1995 is estimated for 6-8 hours after probe power on. This is the time of the nominal probe mission.